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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/691,540	10/24/2003	Kensaku Motoki	33035M0341	6887

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1722	

DATE MAILED: 05/02/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/691,540	Applicant(s) MOTOKI ET AL.
	Examiner Matthew J. Song	Art Unit 1722

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 February 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *4-7,13,16,17,20,25,26,29,30,34-37 and 59* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *4-7, 13, 16-17, 20, 25-26, 29-30, 34-37, and 59* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 2/26/2006 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 4-7 16-17, 20, 25, 26, 29-30 and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheleva et al ("Dislocation density reduction via lateral epitaxy in selectively grown GaN structures") in view of Shakuda (US 5,838,029), and further in view of Mauk (US 5,828,088).

In a method of lateral epitaxy of GaN on a patterned substrate, note entire reference, Zheleva et al discloses an AlN layer is formed on a SiC substrate and a SiO_2 layer is patterned to contain circular windows and striped windows (pg 2472). Zheleva et al also discloses GaN grows vertically and laterally over the mask from the material which emerges over the windows (pg 2473-2474 and Fig 3), this reads on applicant's growing on the mask. Zheleva et al also discloses homoepitaxial growth of GAN pyramids and stripes, this reads on applicant's epitaxial layer growing step (Abstract). Zheleva et al also discloses making a nearly defect free single crystal GaN (pg 2474). Zheleva et al also discloses a SiO_2 layer formed on a GaN/AlN/SiC structure (Fig 3), where GaN reads on applicant's buffer layer. Zheleva et al teaches growth of GaN hexagonal pyramids (Abstract and Fig 1) and laterally growing volumes coalescence resulting in nearly defect free regions without interstices (Fig 5 and pg 2474, col 1).

Zheleva et al do not teach a GaAs substrate.

In a method of making GaN, note entire reference, Shakuda teaches a single crystal substrate of GaAs single crystal is used because its lattice constant is more approximate to that of gallium nitride type semiconductors, thus minimizing distortion on the semiconductor layers (col 10, ln 10-30). Shakuda also teaches the deposition of a low temperature buffer **2** and a high temperature buffer layer **3**. Shakuda also discloses the substrate and the low temperature buffer

layer are then removed by abrading mechanically or chemically at their rear surface (col 10, ln 25-65).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Zheleva et al by using a GaAs substrate because GaAs has a lattice constant more approximate GaN, thereby improving quality, as taught by Shakuda.

The combination of Zheleva et al and Shakuda do not teach the claimed direction the stripe windows extend and the pitch.

In a method of epitaxial lateral overgrowth, note entire reference, Mauk teaches a semiconductor substrate of GaAs is masked with a metal, dielectric or multilayer combination of metals, semiconductors and/or dielectrics (col 5, ln 15-67). Mauk also teaches an epitaxial layer overgrowth process and the mask must be compatible with epitaxial lateral overgrowth of gallium nitride (col 6, ln 1-20). Mauk also teaches the extension of the process to other III-V and II-VI compound semiconductors is straight forward (col 7, ln 40-50). Mauk also teaches the epitaxial layer growing on the mask and the mask layer having a plurality of opening windows disposed separate from each other (Fig 3). Mauk also teaches the alignment of stripes on the wafer surface is also an important factor in optimizing the lateral overgrowth and optimization of stripe opening alignments on other crystallographic orientations and other substrate materials (col 5, ln 55-67), this is a teaching that the stripe direction is a result effective variable.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zheleva et al and Shakuda by optimizing the stripe direction to obtain the claimed direction by conducting routine experimentation (MPEP 2144.05) because optimizing the stripe direction and pitch to obtain the claimed direction and pattern by

conducting routine experimentation (MPEP 2144.05) because stripe direction is a result effective variable, as taught by Mauk.

Referring to claims 5-6, the combination of Zheleva and Shakuda teaches striped windows of 3 and 5 μm (pg 2472, col 1) and the final size of the base GaN pyramids as well as their height depend on the window to mask ratios (pg 2472, col 2), this is a teaching that the mask width is a result effective variable. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zheleva, Shakuda and Mauk by optimizing the mask width by conducting routine experimentation to obtain the claimed mask width (MPEP 2144.05).

Referring to claims 16-17, 20, 25, 26 and 29-30, the claimed direction and pattern can be obtained by routine experimentation by conducting routine experimentation (MPEP 2144.05) because stripe direction is a result effective variable, as taught by Mauk.

Referring to claim 25, 26, 29 and 30, the combination of Zheleva et al, Shakuda and Mauk does not teach the shape of the opening are rectangular windows in an oblong form or hexagonal windows. Different patterns of mask layers used in the selective growth of GaN are known in the art, such as rectangular and hexagonal patterns, as evidenced by Kitamura et al ("Frabrication of GaN Hexagonal Pyramids on Dot-Patterned GaN/Sapphire Substrates via Selective Metalorganic Vapor phase epitaxy") in Fig 1 and Shibata et al ("HVPE growth and properties of a high quality GaN bulk single crystal using selective area growth") in Fig 2. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zheleva et al, Shakuda and Mauk by using a mask

pattern with the claimed shape because changes in shape are held to be obvious (MPEP 2144.04) and the claimed shapes are conventionally used in the selective growth of GaN.

Referring to claim 59, the combination of Zheleva et al, Shakuda and Mauk teach growing epitaxial layers via vapor phase epitaxy (Zheleva pg 2472 and Usui p L899).

4. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zheleva et al ("Dislocation density reduction via lateral epitaxy in selectively grown GaN structures") in view of Shakuda (US 5,838,029) and Mauk (US 5,828,088) as applied to claims 4-7 16-17, 20, 25, 26, 29-30 and 59 above, and further in view of Tadatomo et al (US 5,770,887).

The combination of Zheleva et al, Shakuda and Mauk teaches all of the limitations of claim 13 including forming a buffer layer using OMVPE and MOVPE (Usui pg L899 col 2 and Zheleva pg 2472 col 1), as discussed previously, except the co combination of Zheleva et al, Shakuda and Mauk does not teach forming the buffer using hydride vapor phase epitaxy.

In a method of making GaN, note entire reference, Tadamoto et al teaches permitted epitaxial growth of material to form GaN single crystal and buffer layer include vapor phase epitaxy, hydride vapor phase epitaxy, and metal organic vapor phase epitaxy (col 4, ln 35-40, col 1, ln 40-45 and col 2, ln 10-25), this is a teaching MOVPE and HVPE are equivalent methods of forming buffer layers.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zheleva et al, Shakuda and Mauk by using HVPE instead of MOVPE because Tadamoto et al teaches HVPE and MOVPE are equivalent methods of

forming GaN buffer layer and substitution of known equivalents for the same purpose is held to be obvious (MPEP 2144.06).

5. Claims 34 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheleva et al ("Dislocation density reduction via lateral epitaxy in selectively grown GaN structures") in view of Shakuda (US 5,838,029) and Mauk (US 5,828,088), as applied to claims 4-7 16-17, 20, 25, 26, 29-30 and 59 above, and further in view of IBM (Abstract of "Method of Producing Gallium nitride Boules for Processing into Substrates").

The combination of Zheleva et al, Shakuda and Mauk teaches all of the limitations of claim 34, as discussed previously, except forming an ingot and cutting the ingot into a plurality of sheets.

In a method of making GaN substrates, note entire reference, IBM teaches forming GaN boules using halide vapor phase epitaxy, this reads on applicant's ingot. IBM also teaches the boule is diced into numerous GaN substrates which would be available at reasonable prices for GaN based optoelectronic device growth (Disclosure), this reads on applicant's cutting step into a plurality of sheets. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zheleva et al, Shakuda and Mauk with IBM's method of forming GaN substrates to form useful substrates at a reasonable price.

6. Claims 35 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zheleva et al ("Dislocation density reduction via lateral epitaxy in selectively grown GaN structures") in view of Shakuda (US 5,838,029) and Mauk (US 5,828,088), and further in view of IBM

("Method of Producing Gallium nitride Boules for Processing into Substrates") as applied to claims 34 and 36 above, and further in view of Inoue (Us 5,182,233)

The combination of Zheleva et al, Shakuda, Mauk and IBM teaches all of the limitations of claim 34, as discussed previously, except a cleaving step of cleaving the ingot into a plurality of sheets.

In a method of dicing crystals, note entire reference, Inoue teaches a compound semiconductor wafer formed of a single crystal is diced along a cleavage plane since along this plane the single crystal easily splits (col 1, ln10-40), this reads on applicant's cleaving step. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zheleva et al, Shakuda, Mauk and IBM by dicing along the cleaving plane, as taught by Inoue, because the single crystal easily cracks along the cleavage plane.

Response to Arguments

7. Applicant's arguments, see page 8 of the remarks, filed 2/16/2006, with respect to the rejections in view of Usui et al have been fully considered and are persuasive. The rejection of claims 4-7, 13, 16-17, 20, 25-26, 29-30, 34-37, and 59 has been withdrawn. Usui et al does not teach forming hexagonal crystals.

8. Applicant's arguments filed 2/16/2006 have been fully considered but they are not persuasive.

Applicant's argument that Zheleva does not teach hexagonal pyramids and each crystal connects with other crystals on the mask layer without interstices is noted but is not found

persuasive. Zheleva explicitly teaches growth of GaN hexagonal pyramids (Abstract and Fig 1) and laterally growing volumes coalescence resulting in nearly defect free regions without interstices (Fig 5 and pg 2474, col 1).

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Nam et al ("Lateral epitaxy of low defect density GaN layer via organometallic vapor phase epitaxy") teaches overgrowth of GaN on a SiO_2 mask (Fig 1 and Abstract).

Sakai et al ("Defect structure in selectively grown GaN films with low threading dislocation density") teaches overgrowth of GaN on a SiO_2 mask and GaN buffer layer (Fig 1 and Abstract).

Kitamura et al ("Frabrication of GaN Hexagonal Pyramids on Dot-Patterned GaN/Sapphire Substrates via Selective Metalorganic Vapor phase epitaxy") teaches dot-patterned windows in a SiO_2 mask with hexagons with a width of 5 mm and a spacing of 10 mm in the <11-20> direction (Experimental Procedure and Fig 1).

Shibata et al ("HVPE growth and properties of a high quality GaN bulk single crystal using selective area growth") teaches epitaxial lateral overgrowth of GaN on a SiO_2 mask and the mask is patterned with rectangular windows (Abstract and Fig 2).

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Yogendra Gupta can be reached on 571-272-1316. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song
Examiner
Art Unit 1722

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MJS
April 26, 2006